Aug. 11, 1925. 1,549,191

H. A. FISHER

METHOD OF ANNEALING METAL AND APPARATUS THEREFOR

Filed Oct. 15, 1923 2 Sheets-Sheet 1

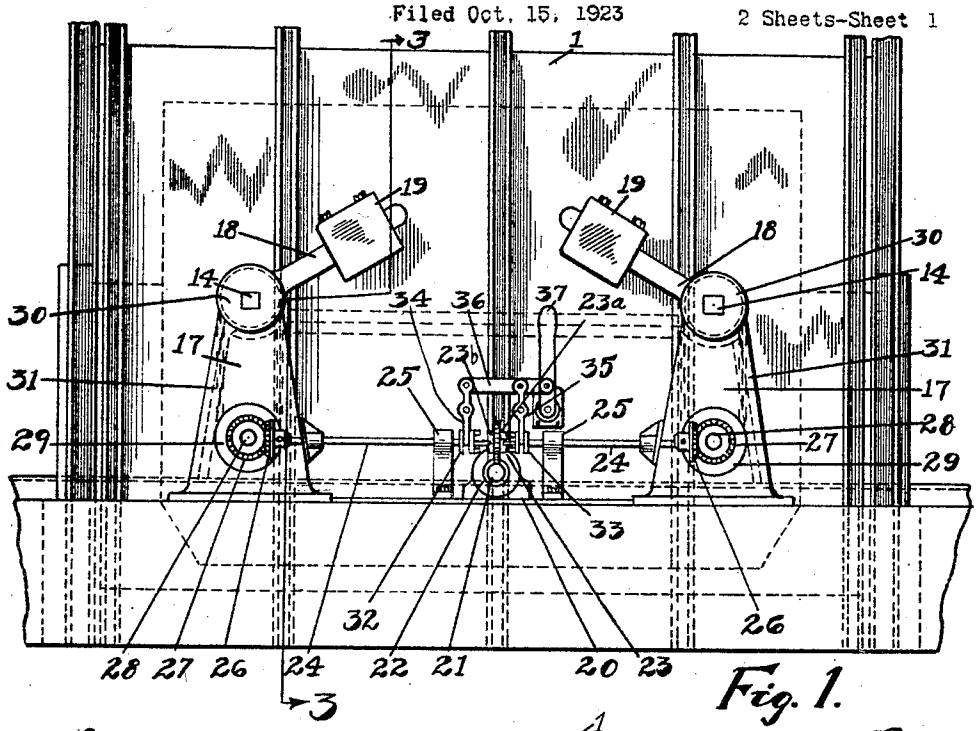


Fig. 1.

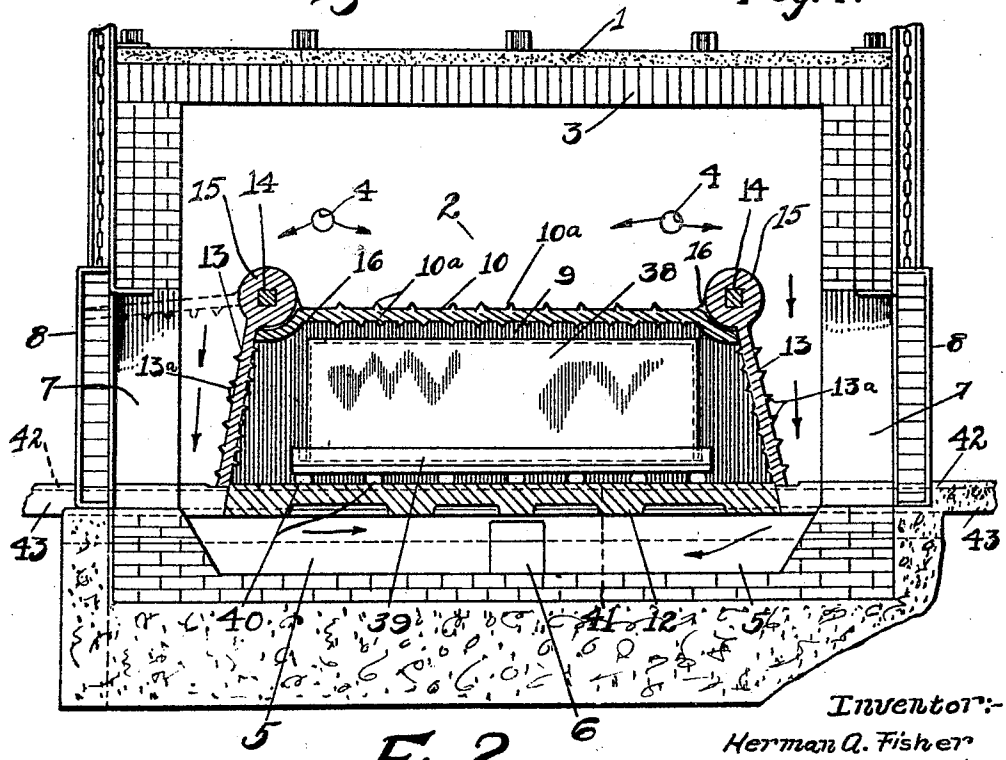


Fig. 2.

Inventor:-
Herman A. Fisher
by Owen W. Kennedy
Attorney

Aug. 11, 1925. 1,549,191

H. A. FISHER

METHOD OF ANNEALING METAL AND APPARATUS THEREFOR

Filed Oct. 15, 1923 2 Sheets-Sheet 2

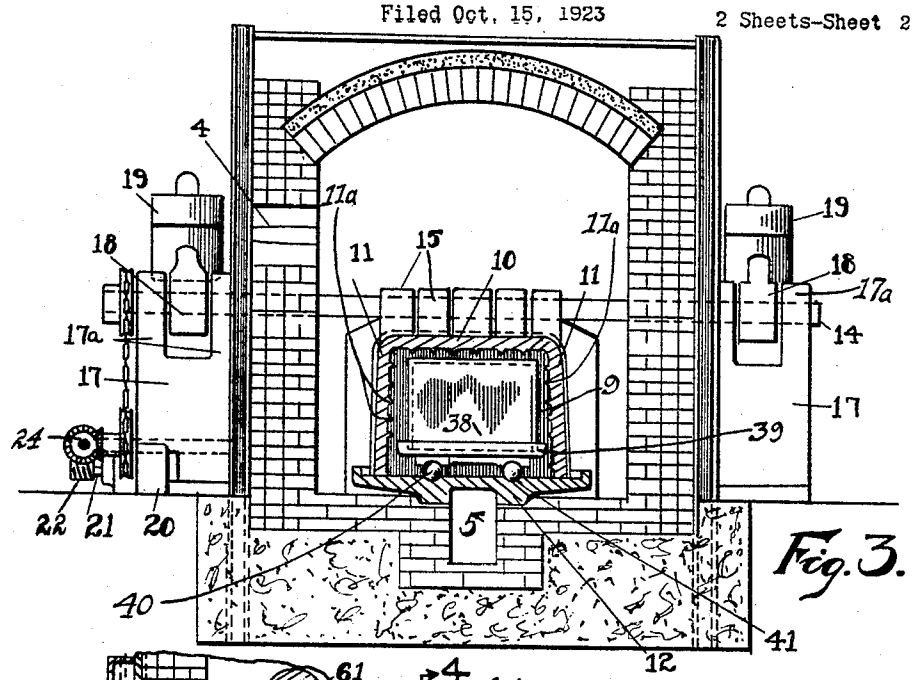


Fig. 3.

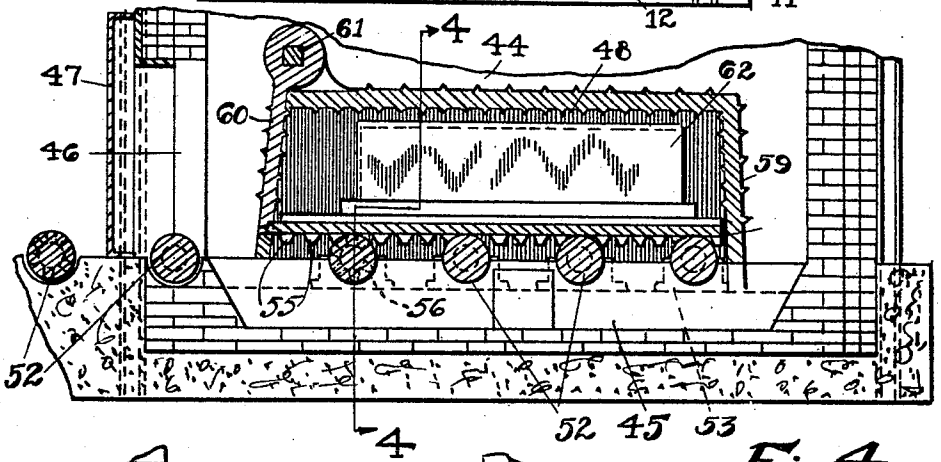


Fig. 4.

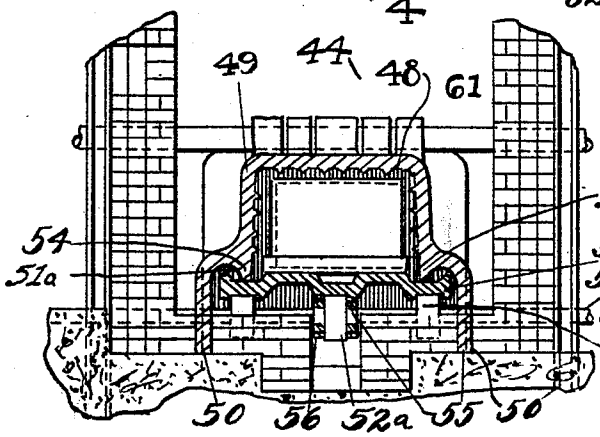


Fig. 5.

Inventor:-
Herman A. Fisher
by Owen R. Kennedy
Attorney

Patented Aug. 11, 1925. 1,549,191

UNITED STATES PATENT OFFICE.

HERMAN A. FISHER, OF WORCESTER, MASSACHUSETTS.

METHOD OF ANNEALING METAL AND APPARATUS THEREFOR.

Application filed October 15, 1923. Serial No. 668,620.

To all whom it may concern:

Be it known that I, HERMAN A. FISHER, a citizen of the United States, residing at Worcester, in the county of Worcester and Commonwealth of Massachusetts, have invented a new and useful Improvement in a Method of Annealing Metal and Apparatus Therefor, of which the following, together with the accompanying drawings, is a specification.

My invention relates to the art of annealing, or heat treatment of metal, and relates particularly to a method of and apparatus for carrying out what is commonly known as "bright annealing", that is, heat treatment without oxidation, or discoloration, of the metal.

In order to successfully carry on the annealing without oxidation, or discoloration, two things are essential, first the metal must be effectively protected from direct contact with products of combustion, while undergoing heat treatment, and second, the metal must be allowed to cool after heat treatment in an atmosphere free from oxygen. Bright annealing has been heretofore carried on by enclosing the metal to be heated in one or more metallic receptacles, or boxes, which are inserted in the furnace, where the outer receptacle, if two are used, is exposed to the products of combustion passing through the furnace. When the metal under treatment has been heated to the desired degree, the metal boxes are withdrawn from the furnace and allowed to cool before opening and removing the metal therefrom. It has been found that the boxes which are exposed to the direct action of the products of combustion within the furnace rapidly deteriorate, due to oxidation and warping caused by repeated heating and cooling, thereby requiring frequent replacement. It has also been found that when the outside boxes are constructed of metal heavy enough to withstand repeated heating, a great amount of heat is lost from the furnace every time the heated box is withdrawn with a charge therein. Furthermore, a large number of boxes must be available for use when operating a furnace continuously, because of the fact that the length of time required for cooling a heated box after withdrawal, is much longer than the time usually required for heating a box and its charge. Obviously, the introduction of a cold box, or boxes, directly into the combustion chamber of the furnace with each new charge is also wasteful of heat and tends to cause uneven operation of the furnace.

According to the present invention I provide an improved method of and apparatus for carrying on bright annealing, in which the repeated heating and cooling of the heavy outer boxes, is entirely eliminated, with a consequent saving of heat and box material. Briefly stated, my invention contemplates placing each charge in a sealed metal box of relatively light material, which in turn is placed within an inner chamber, or muffle, forming a part of the furnace proper, although effectively protecting the charge from the heated products of combustion. My invention further contemplates means whereby the withdrawal of the charge boxes from the inner chamber for subsequent cooling may be carried out without material loss of heat from the inner chamber.

The above and other advantageous features of my invention will hereinafter more fully appear, reference being had to the accompanying drawings in which—

Fig. 1 is a view in side elevation of a furnace adapted for carrying out my invention.

Fig. 2 is a longitudinal sectional view of the furnace shown in Fig. 1.

Fig. 3 is a transverse sectional view along the line 3—3 of Fig. 1.

Fig. 4 is a view similar to Fig. 2, showing a portion of a modified form of furnace.

Fig. 5 is a partial sectional view along the line 5—5 of Fig. 4, looking in the direction of the arrows.

Like reference characters refer to like parts in the different figures.

Referring to Figs. 1 and 2, the furnace proper consists of a casing, or shell, 1 enclosing a combustion chamber 2 having a lining 3 of fire brick, or other refractory material. A suitable combustible mixture consisting of inflammable gas, oil, or powdered coal and air, is introduced into the combustion chamber 2 through burners, or ports, 4 extending through the walls of the chamber at any desired point. Discharge flues 5 and 6 are provided for withdrawing the waste products of combustion from the chamber 2, and as the flues 5 and 6 are connected to a suitable exhausting mean, not shown, it is evident that the discharge of the waste products through these

flues will induce a circulation of the burning gases, or other medium, within the chamber 2. For purposes of illustration, the ports 4 are shown as being provided in a side wall of the chamber 2, while the flues 5 and 6 are arranged in the bottom of the chamber, so that the circulation is generally downward, as indicated by the arrows. It is to be understood however, that the introduction of combustible matter into the chamber 2, and the circulation of the products of combustion therein, can be brought about in other ways than as shown, without departing from my invention.

Each end of the chamber 2 is provided with an opening 7 adapted to be closed by a vertically movable door 8 to give access to an inner heating chamber, or muffle, 9 centrally located within the combustion chamber 2. The chamber 9 is enclosed by a top 10 and side walls 11 composed of a suitable refractory material, such as carborundum, or of some metal, or alloy, of a heat resistant nature. The bottom 12 of the chamber 9 is directly exposed to the heating medium passing out through the flues 5 and 6, and the bottom 12 is of such length that the ends 13 of the chamber 9 are exposed directly to the heating medium passing from the chamber downwardly to the flues 5 and 6. With this arrangement, the material composing the top, bottom, sides and ends of the chamber 9 is exposed directly to the products of combustion when the furnace is in operation. One, or both sides of the material forming the walls of the chamber 9 are provided with ribs or fins 10^a, 11^a and 13^a, respectively, thereby increasing the radiating surface and heat conductivity of the walls of the chamber, and at the same time stiffen and strengthen the same.

The ends 13 of the chamber 9 are adapted for swinging movement on shafts 14 extending transversely through the furnace, as best shown in Fig. 3. Each end, or door, 13, as it will be hereinafter referred to, is provided with cylindrical lugs 15 for receiving its shaft 14, the top 10 being provided at its ends with concave seats 16 which receive the lugs 15 and permit turning movement therein. When the doors 13 are closed, each door is adapted to abut end surfaces of the top 10 and the bottom 12 of the chamber 9, so as to effectively seal the chamber against admission of gases from the combustion chamber 2. My invention also contemplates the use of vertically sliding doors, or doors swinging horizontally.

Each cross shaft 14 projects at its ends beyond the furnace casing 1 and is slidably supported in upwardly extending bearing brackets 17. Each bracket 17 is bifurcated, and a lever 18 is mounted on the shaft 14 between each pair of spaced arms 17^a of a bearing bracket 17. Each lever 18 carries a weight 19 adjustable thereon, the weights 19 tending to counterbalance the weight of the doors 13 so that the latter may be readily swung by mechanism which will now be described, with reference to Fig. 1.

An electric motor 20, or any other suitable source of power, is located between the bearing brackets 17, and its shaft 21 is provided with a worm 22 in mesh with a worm wheel 23 loosely mounted on alined shafts 24 supported for independent rotation in bearings 25. Each shaft 24 is provided at its end with a bevel gear 26 in mesh with a gear 27 carried by a shaft 28 rotatably mounted in the bearing bracket 17 carrying the shaft 14. A pulley 29 is mounted on each shaft 28, and is connected to a pulley 30 on the corresponding shaft 14 by means of a chain, or belt, 31.

The worm wheel 23 is provided on opposite faces thereof with spaced dogs 23^a and 23^b which are adapted to be engaged by correspondingly spaced dogs provided on clutching members 32 and 33, each slidably keyed to a shaft 24. The clutching members 32 and 33 are adapted to be moved longitudinally on the shafts 24 by means of pivoted shifting levers 34 and 35 respectively. The levers 34 and 35 are connected by means of a link 36 to a pivotally mounted operating handle 37. It will be apparent from an inspection of Fig. 1, that movement of the handle 37 to the right will cause the clutching member 33 to be engaged with the right hand dogs 23^a on the worm wheel 23, while the clutching member 32 will be held out of engagement with the dogs 23^b. When the worm wheel 23 is thus clutched to the right-hand shaft 24 by the member 33, operation of the motor 20 in one direction will cause the shafts 24 and 14 to be turned in such a direction as to open the right-hand door 13 of the chamber 9, while operation of the motor in the other direction closes the door, the parts being shown in this position. When the handle 37 is moved to the left, the clutching member 33 will be disengaged and the clutching member 32 will then connect the worm wheel 23 to the left-hand shaft 24, through dogs 23^b. When this occurs, it is obvious that operation of the motor will cause the shaft 14 to swing the left-hand door 13 open, or shut.

As best shown in Fig. 2, the heating chamber 9 is of such size as to readily receive a box or container, 38 which holds the metal under heat treatment, or, if desired, the material may be placed in open pans, or on the floor of the chamber 9. The box 38 is rectangular in form and its lower portion is received in a trough-like bottom 39 which may contain a suitable sealing substance for rendering the joint between the box 38 and the bottom 39 substantially air-tight. The bottom 39 of the box 38 is

supported above the base 12 of the chamber 9 on a plurality of balls 40, or other suitable anti-friction devices, whereby the box 38 will be readily moved within the chamber 9. As shown, the balls 40 are adapted to travel in longitudinal grooves 41 provided in the base 12, the grooves 41 being in alinement with the grooves 42 provided in suitable rails 43 extending into each end of the furnace below the doors 8.

In carrying out my improved method in connection with the furnace just described, a large number of boxes 38 are provided, within which are placed suitable charges of the material to undergo heat treatment, the boxes being sealed when desired by placing a suitable substance in the bottoms 39. One door 8 of the combustion chamber 2 is then raised, after which the motor 20 is operated with the handle 37 in the proper position to cause one of the shafts 14 to be turned in such a direction as to swing the corresponding door 13 of the heating chamber 9 outwardly. The doors 13 are adapted to swing into the openings 7, as shown in dotted lines in Fig. 2. A box 38 with a charge therein may then be moved into the chamber 9 on its rolls from the open side of the furnace, after which the door 13 is closed by driving the shaft 24 in the reverse direction. The furnace door 8 is then lowered to close the combustion chamber 2, and the heating medium is admitted to the chamber 2 by suitable control devices, not shown. The hot gases then circulate in the combustion chamber 2 on all sides of the heating chamber 9, so that the chamber 9 soon becomes heated to the desired temperature, the projecting fins assisting in conducting heat through the walls. The heat within the chamber 9 is conducted to the charge within the box 38 by reason of the fact that the walls of the box are relatively thin and are composed of good heat conducting material as previously pointed out. When the charge within the box 38 has been subjected to heat for the desired length of time, the flow of the heating medium to the combustion chamber 2 is shut off and the furnace doors 8 are raised.

One, or both of the doors 13 is then swung into the open position, as previously described, the heated box removed, and a second box 38 containing a fresh charge is pushed into the chamber 9. The doors 13 are then immediately swung closed, the doors 8 lowered, and the heating process again started in chamber 2. It is obvious that the time required to move a cold box 38 into the chamber 9 and withdraw a heated box therefrom is very short, so that the combustible matter can be again admitted to the combustion chamber 2 before the walls of either the chamber 2 or the chamber 9 have had an opportunity to cool off to any appreciable extent. For this reason, the amount of heat required for the second and succeeding charges is very much less than that required for heating the first charge. It is obvious that the only heat lost from the furnace is that contained in the heated charge boxes when withdrawn from the furnace, together with a certain amount of heat loss when the furnace doors are open during the transfer.

It is obvious that a heated box and its charge can be allowed to cool after it has been withdrawn, and that the time required for cooling in no way affects the continuous operation of the furnace with other boxes. While the boxes 38 are constructed of relatively light material, it is obvious that these boxes will not deteriorate rapidly from repeated heating and cooling, owing to the fact that a box is effectively protected from the action of combustion gases while it is in the heating chamber 9. As previously pointed out, the walls of the chamber 9 are constructed of relatively thick heat resisting material, so that the whole furnace can be operated continuously for a long period without requiring any replacement of the parts thereof.

The provision of a permanent sealed heating chamber 9 within the combustion chamber 2 for receiving the charge boxes, renders my method of bright annealing much more effective from the standpoint of both economy and speed, than the methods heretofore practiced, in which the box or boxes containing the charge are moved directly into the combustion chamber of the furnace where the outer box is subjected to the combustion gases. In previous practice, the outer box must be withdrawn in order to remove a heated charge, thereby resulting in a great loss of heat from the furnace. Furthermore, a cold outer box must be moved into the combustion chamber with each new charge, which box must be heated before the heat can be conducted to the inner box. A still further advantage of my method lies in the fact that only a limited number of relatively light and inexpensive charge boxes are required, whereas the previous method requires the provision of heavy boxes so constructed as to withstand the intense heat of the combustion chamber, and the warping and oxidizing due to repeated heating and cooling.

Referring now to Figs. 4 and 5, there is shown a modified form of furnace for carrying out my invention. The general construction of the furnace proper, as regards the combustion chamber 44 and the passages 45 for discharging the heating medium from the chamber, is substantially the same as the complete furnace, as shown in Fig. 2, so that only a portion of the combustion chamber 44 is shown in Figs. 4 and 5, for pur-

poses of illustration. One end wall of the chamber 44 is provided with an opening 46 adapted to be closed by a vertically movable door 47, the opposite end of the chamber 44 being solid.

A heating chamber 48 is centrally located within the combustion chamber 44, and as best shown in Fig. 5, the top and side walls thereof are constituted by an inverted U-shaped member or casting 49 having flanges 50 extending downwardly into the masonry forming the bottom of the combustion chamber 44. The bottom 51 of the heating chamber 48 extends between the flanges 50 and is supported on a plurality of pairs of rollers 52, rotatably mounted in suitable bearings 53. The member 49 is provided with downwardly projecting lips 54 extending longitudinally thereof, which lips 54 are adapted to be sealed by sand contained in grooves 51^a provided in the upper surface of the base 51.

An under surface of the base 51 is provided with a plurality of teeth 55 which are in engagement with teeth provided on suitable pinions 56 mounted on opposite sides of the middle roller 52^a of one, or more, of the sets of rollers. The shaft 57 on which the roller 52^a is mounted extends beyond the side wall of the combustion chamber 44, and is adapted to be connected to a suitable source of power, such as an electric motor 58. Obviously, rotation of the shaft 57 will cause the base 51 of the heating chamber 48 to be moved within the chamber in either direction.

One end of the chamber 48 is closed by a wall 59 integral with the member 49, while the other end is adapted to be closed by the door 60, mounted for pivotal movement on a shaft 61 extending transversely through the combustion chamber 44. The ends of the shaft 61 are provided with weighted arms in substantially the same manner as the shafts 14, and further means are provided for turning the shaft 61 in either direction of rotation to move the door 60 from its closed position, shown in full lines, to its open position, as shown in dotted lines in Fig. 4. The means for controlling the movement of the door 60 is preferably of substantially the same character as the door controlling mechanism illustrated in Fig. 1. This form of my invention also contemplates the use of a vertical sliding door or a horizontally swinging door.

When it is desired to charge the furnace illustrated in Figs. 4 and 5, the combustion chamber door 47 is raised, after which the door 60, mounted for pivotal movement on tion. The shaft 57 is then driven in a counterclockwise direction, as viewed in Fig. 4, to cause the base 51 to be moved out of the chamber 48 and through the opening 46. The base 51 is of such length that when the teeth 55 at its right-hand end are engaged by the pinions 56, its left-hand end will be supported on those sets of rolls 52 which are located outside of the combustion chamber 44. A box or container 62 of substantially the same form as the box 38, is then placed on the base 51, the box 62 containing a quantity of metal for heat treatment, and being sealed. The shaft 57 is then driven in a clockwise direction to cause the base 51 to be moved back into the chamber 48, after which the doors 60 and 47 are closed. Heated gases are then admitted to the combustion chamber 44 to bring about heat treatment of the metal within the box 62, after which the doors 47 and 60 are opened and the base 51 moved out to permit the heated box to be removed therefrom and a box containing a fresh charge substituted therefor. It is obvious that an interchange of boxes can be effected very quickly without any material loss of heat from the combustion chamber 44, owing to the fact that the doors 47 and 60 are open only a very short time. The fact that one end of the combustion chamber 44 is always closed further reduces heat losses during an interchange of charge boxes.

From the foregoing it is apparent that by my invention I have provided an improved method of and apparatus for carrying on bright annealing, whereby the heat losses due to the placing of successive charges in the furnace, are reduced to a minimum. Furthermore, in my improved furnace the parts subjected to the direct action of the products of combustion are of a more or less permanent nature, so that they can be made of rugged construction of a heat resistant material. The containers which are placed in and removed from the furnace are adequately protected against action of the combustion gases and so can be made of relatively light material having a high heat conductivity.

I claim,

1. Apparatus for the heat treatment of metal, comprising a furnace providing a combustion chamber having an opening normally closed by a movable door, and a closed chamber located within said combustion chamber and having a movable closure adapted to be moved into the opening of said combustion chamber when said door is raised.

2. Apparatus for the heat treatment of metal, comprising a furnace having a combustion chamber with an opening normally closed by a movable door, a closed chamber located within said combustion chamber and provided with a movable closure, and means located outside of said furnace for moving said closure into the opening of said combustion chamber when the door of the latter chamber is raised.

3. Apparatus for the heat treatment of

metal, comprising a furnace having a combustion chamber surrounding a closed heating chamber, anti-friction devices for supporting a charge within said heating chamber and means for removing said charge from said chamber by power.

4. Apparatus for the heat treatment of metal, comprising a furnace having a combustion chamber surrounding a closed heating chamber provided with a movable closure, anti-friction devices for supporting a charge within said heating chamber, whereby said charge may be removed from said chamber when the said closure is in its open position and means for removing said charge from said chamber by power.

5. Apparatus for the heat treatment of metal, comprising a furnace having a combustion chamber surrounding a closed heating chamber provided with a movable closure, and means comprising a rack and gear, the latter being operable from the outside of said furnace for moving a charge either into or out of said heating chamber.

6. Apparatus for the heat treatment of metal, comprising a furnace having a combustion chamber surrounding a closed heating chamber provided with a movable closure, anti-friction devices for supporting a charge within said heating chamber, and means comprising a rack and gear, the latter being operable from the outside of said furnace for moving said charge within said heating chamber.

7. Apparatus for the heat treatment of metal, comprising a furnace having a combustion chamber surrounding a closed heating chamber provided with a movable closure, anti-friction devices for supporting a charge within said heating chamber, and means comprising a rack and gear, the latter being operable from outside of said furnace for moving said charge either into or out of said heating chamber.

8. Apparatus for the heat treatment of metal, comprising a furnace having a combustion chamber, entirely within which is located a closed chamber having a swinging balanced door, and means for operating said door from the outside of said furnace.

9. Apparatus for the heat treatment of metal, comprising a furnace having a combustion chamber, entirely within which is located a closed chamber having a swinging balanced door, a shaft extending through said furnace supporting said door, and adapted by its rotation to open and close it, and means for operating said door from the outside of said furnace.

10. Apparatus for the heat treatment of metal, comprising a furnace having a combustion chamber, entirely within which is located a closed chamber having a swinging balanced door, a shaft extending through said furnace supporting said door and adapted by its rotation to open and close it, and means including gearing and a clutch for turning said shaft from the outside of said furnace.

HERMAN A. FISHER.